ATTACHMENT A

TOP IMPACT RESISTANCE TEST - FORCE (NFPA 1971-2000, Section 6-15)

GENERAL

Three helmets shall be tested after each of the following conditions:

Room Temperature, Low Temperature, Conventive Heat, Radiant Heat, and Wet Conditioning.

There will be three helmets for each conditioning for a total of 15 helmets.

6-1.3 - ROOM TEMPERATURE CONDITIONING PROCEDURE FOR HELMETS, FACESHIELD/GOGGLE COMPONENTS: Helmet and faceshield/goggle components shall be conditioned at a temperature of 21°C, ±3°(70°F, ±5°F) and a relative humidity of 25 percent to 50 percent. Specimens shall be tested within 5 minutes after removal from conditioning.

6-1.4 - LOW TEMPERATURE ENVIRONMENTAL CONDITIONING PROCEDURE FOR HELMETS: Sample specimens shall be conditioned by exposing them to a temperature of -32°C, ±1°C (-25°F, ± 2°F) for at least 4 hours. The impact/penetration test shall be completed within 15 seconds, ±5 seconds after removal from the cold temperature environment, or the specimens shall be reconditioned before testing.

6-1.5 - CONVECTIVE HEAT CONDITIONING PROCEDURE FOR HELMETS: Samples shall be conditioned by exposing them to the following procedures specified:

The test oven shall be a horizontal flow circulating oven with the minimum interior dimensions of 610 mm x 610 mm x 610 mm (24 in. x 24 in. x 24 in.).

The test thermocouple shall be positioned so that it is level with the horizontal centerline of a mounted test helmet. The thermocouple shall be equidistant between the vertical centerline of a mounted test helmet placed in the middle of the oven and the oven wall where the airflow enters the test chamber.

The test oven temperature shall be stabilized at 140°C, +6°C/-0°C (285°F, +10°F/0°F) for a period of not less than 30 mins., +15/-0 seconds.

Helmets with ear covers deployed and with the faceshield/goggle component in the stowed position shall be seated on the noncunductive headform specified in Firgure 6-6.12.3 and shall be positioned according to the helmet's positioning index. The headform with the helmet attached shall be placed in the center of hte test oven with the centerline of the front of the helmet facing the airflow.

The oven door shall not remain open more than 15 seconds. The air circulation shall be shut off while the door is open sand turn on when the door is closed. The total oven recovery time after the door is closed shall not exceed 30 seconds.

TOP IMPACT RESISTANCE TEST - FORCE (Cont'd) (NFPA 1971-2000, Section 6-15)

One helmet shall be test at a time. The entire specimen shall not be less than 50 mm (2 in.) from any oven surface.

The specimen, mounted as specified, shall be exposed in the test oven for 10 minutes, +0.15/-0 minute. The test exposure time shall begin when the thermocouple recovers to a temperature of 140°C, +6°C/-0°C, (285°F, +10°F/-0°F).

The required testing shall be performed within 15 seconds, +/-5 seconds.

6-1.6 - RADIANT AND CONVECTIVE ENVIRONMENTAL HEAT CONDITIONING PROCEDURE FOR HELMETS: Sample helmets shall be conditioned by exposing the are to be impacted/penetrated to a radiant heat source. The top, sides, front, and back test areas to be impacted/penetrated shall be as specified in Fig. 6-1.6.1.
The area to be impacted/penetrated shall be exposed to a irradiance of 1.0 W/cm², ±0.1 W/cm² for a length of time determined by exposure of a radiant heat transducer. The heat source shall be removed and the helmet shall be tested. The helmet shall be impact/penetrated in 15 seconds, ±5 seconds after removal from the conditioning environment of the helmet shall be cooled to room temperature and reconditioned before testing.
The radiometer shall have a spectral response to flat within ±3 percent over a range of at least 1.0 mm to 10.1 mm (0.00004 in to 0.0004 in.) and an overall accuracy of at least ±5 percent of the reading.
The radiant panel shall have an effective radiating surface of 150 mm, ±6 in.,±0.25 in.) square. The spectral radiant emittance curve of the radiant panel shall be that of a black body at a temperature of 1000°K, ±200°K (1340°F,±360°F).

The radiant heat transducer shown in Fig. 6-1.6.5 shall be constructed from sheet copper, ASTM B 152, *Specification for Copper Sheet, Strip Plate, and Rolled Bar,* Type 110 ETP, half hard, 0.64 mm, ±5 mm (2 in., ±1/64 in.) square. A constantan wire 0.81 mm, ±0.5 mm (0.032 in., ±0.002 in.) in diameter and an iron wire of the same diameter shall be silver soldered 15 mm, ± 1 mm from the edges of the copper sheet on the same side, as shown in Fig. 6-1.6.5. The side of the copper sheet opposite that with the wires attached shall be painted flat black. The resulting transducer is a Type J thermocouple that shall be used in conjunction with appropriate instrumentation to monitor the heat exposure to which the helmet if to be subjected.

Sample helmets shall be mounted in the position to be conditioned. The point of impact or penetration on the helmet shall be determined in accordance with the specific test to be performed. the helmet shall be removed temporarily, and a radiometer shall be located at that point perpendicular to and facing away from the helmet surface.

The radiant panel shall be introduced in front of the radiometer with its effective radiating surface parallel to the plane tangent to the helmet surface at the center of the impact/penetration site on the helmet. The radiant panel shall be adjusted to obtain a stable uniform irradiance of 1.0 W/cm², W/cm² over a minimum 75 mm (3 in.) diameter circle located on the

above plane and centered at the center of impact or penetration. Stability shall be achieved when the irradiance changes by less than 10 percent during a 3 minute period.

TOP IMPACT RESISTANCE TEST - FORCE (Cont'd) (NFPA 1971-2000, Section 6-15)

The radiometer shall be replaced with the radiant heat transducer. The center of the transducer shall be positioned with its center coincident with the center of the impact/penetration site on the helmet and parallel to the plane tangent to the helmet surface at that point. The flat black surface of the transducer shall face the radiant panel. The time required for the transducer to reach a temperature of 260°C (500°F) shall be recorded. That time shall be 2.5 minutes, ±15 seconds. A closed, insulated chamber shall be required to achieve this exposure time.

The chamber and helmet shall be stabilized at 25°C, ±5°C (77°F, ±9°F). The helmet shall be positioned in the chamber in the same position specified in 6-1.6.6. The helmet shall be subjected to the exposure conditions specified in 6-1.6.1 for the time recorded in 6-1.6.8. The exposure time shall not be less than the time recorded in 6-1.6.8, nor more than 5 seconds longer than that time.

6-1.7 WET CONDITIONING PROCEDURE FOR HELMETS AND FACESHIELD/GOGGLE COMPONENTS: Sample specimens shall be conditioned by immersing them in water at a temperature of 20°C to 28°C (68°F to 82°F) for at least 4 hours but not more than 24 hours. The specimen shall be tested withing 10 minutes after removal from water.

APPARATUS

An aluminum ISEA size 7 headform shall be used. The headform shall have a mass of 3.6 kg, ±0.5 kg *8 lb, ±1 lb.) and shall be of the nominal dimensions of the headform in Table 6-15.4.1 and Figures 6-15.4.1 (a) through (c).

A steel drop mass of 3.58 kg, ±0.05 kg (7.90 lb, ±0.10 lb) shall be used. The striking face of the drop mass shall be a spherical segment with a radius of 50 mm, ±8 mm (1 7/8 in., ± 5/16 in.) and a chord length of at least 75 mm (3 in.).

An electronic force measurement system with the following minimum specifications shall be used:

(1) Range - 4450 N (1000 lbf)
(2) Peak force measurement accuracy - ±2.5 percent
(3) Resolution - 22 N (5 lbf)
(4) Load cell rigidity - 4.4 x 10^9 N/m (2.5 x 10^7 lbf/in.)
(5) Minimum mechanical resonant frequency of the headform/load cell system - 5000 Hz
(6) Load cell diameter - 75 mm (3 in.)

TOP IMPACT RESISTANCE TEST - FORCE (Cont'd) (NFPA 1971-2000, Section 6-15)

The system frequency response shall comply with SAE J211, *Instrumentation for Impact Test*, Channel Frequency Class 1000, specifications. The minimum mechanical resonant frequency shall be calculated from the following formula:

$$f = \frac{(\sqrt{kg/m})}{2\pi}$$

where:

kg = load cell rigidity [N/m (lbf/ft)]

m = mass of the structure on top of the load cell [kg(slugs)]

All surface in contact with the load cell shall have a surface finish of at least 0.8×10^{-6} m (32×10^{-6} m) rms. In addition, those surfaces in contact with the load cell shall be flat to within 12.7×10^{-6} m (500×10^{-6} m).

The load cell shall have a backup mass of at least 540 kg (1200 lb). The load cell assembly shall be rigidly mounted between the headform structure and a steel plate at least 305 mm (1 ft) square and 25 mm (1 in.) thick. The backup mass shall be concrete or a rigid material of equal or greater density at least 610 mm^2 (2 ft^2).

The surface of the steel plate, in the area of the load cell assembly mounting, shall be flat within $\pm$0.15 mm ($\pm$0.005 in.) and within 1 degree of level. The steel plate shall be rigidly attached to, and in intimate contact with, the backup mass.

The vertical centerline of the drop mass, the headform, and the load cell shall all be colinear within 3 mm (1/8 in.). The sensitive axis of the load cell shall be aligned within 1 degree of vertical. The guide or guides shall be vertical, and in the case of a double guide system, parallel to within 6.4 mm per 3 m (1/4 in. per 10 ft) of length.

The instrumentation calibration shall be verified at least before and after each test series or at the beginning and end of each day of testing, whichever is the shorted length of time.

The test system shall be analyzed dynamically to ensure that any mechanical resonance associated with transducer mountings do not distort the output data.

Prior to testing, the instrumentation shall be allowed to warm up until stability to achieved.

Throughout calibration, verification, and testing, the ambient temperature shall be 20°C to 28°C (68°F to 82°F) and relative humidity shall be 30 percent to 70 percent.

TOP IMPACT RESISTANCE TEST - FORCE (Cont'd) (NFPA 1971-2000, Section 6-15)

METHOD

Where faceshield/goggle component(s) are provided, the device shall be removed from the helmet for this test. Specimen helmets shall be adjusted to a size sufficient to properly fit on the headform. Specimens shall be positioned on the headform with the horizontal center plane parallel within 5 degrees of the reference plane. The front-to-back centerline of the shell shall be within 13 mm (1/2 in.) of the midsagittal plane of the headform. Specimens shall be subjected to the environmental conditions specified in 6-1.3, 6-1.4, 6-1.5, 6-1.6, and 6-1.7 prior to each impact and within the specified time after being removed from conditioning.

The impactor shall be dropped from a height that yields an impact velocity within 2 percent of 5.47 m/sec (17.9 ft/sec). A means of verifying the impact velocity to within 2 percent for each impact shall be incorporated.

The verification tests shall demonstrate an accuracy of 2.5 percent or better in the measured force.

REPORT

The results of each system verification shall be made part of the test results for specimens being tested.

The peak force and impact velocity shall be recorded for each test.

INTERPRETATION

Pass or fail performance shall be determined for each specimen. One or more helmet specimens failing this test shall constitute failing performance.

REQUIREMENT

Sample helmets shall not transmit a force of more than 3780 N (850 lbf).

TOP IMPACT RESISTANCE TEST - FORCE (Cont'd) (NFPA 1971-2000, Section 6-15)

RESULTS

CONDITION	SAMPLE#	MODEL	PEAK FORCE (lbf)	VELOCITY (ft/sec)
Room Temp	1	Legacy 4-Under ratchet headband	745	17.9
	2	Legacy 4-Under ratchet headband	695	18.7
	3	Legacy 4-Padded ratchet headband	695	17.6
Low Temp	1	Legacy 4-Under ratchet headband	570	18.3
	2	Legacy 4-Under ratchet headband	586	17.9
	3	Legacy 4-Padded ratchet headband	528	17.8
Convective Heat	1	Legacy 4-Under ratchet headband	603	18.5
	2	Legacy 4-Under ratchet headband	511	18.0
	3	Legacy 4-Padded ratchet headband	436	18.0
Radiant Heat	1	Legacy 4-Under ratchet headband	561	18.1
	2	Legacy 4-Under ratchet headband	553	18.1
	3	Legacy 4-Padded ratchet headband	611	18.3
Wet	1	Legacy 4-Under ratchet headband	611	17.9
	2	Legacy 4-Under ratchet headband	611	18.1
	3	Legacy 4-Padded ratchet headband	645	18.2

OBSERATIONS:

The sample helmets did not transmit a force of more than 3780 N (850 lbf).

TOP IMPACT RESISTANCE TEST - FORCE (Cont'd) (NFPA 1971-2000, Section 6-15)

CONDITION	SAMPLE#	MODEL	PEAK FORCE (lbf)	VELOCITY (ft/sec)
Room Temp	1	Legacy 5-Padded ratchet headband	720	17.8
	2	Legacy 5-Padded ratchet headband	720	17.7
	3	Legacy 5-Padded ratchet headband	704	17.8
Low Temp	1	Legacy 5-Padded ratchet headband	637	18.0
	2	Legacy 5-Padded ratchet headband	620	18.2
	3	Legacy 5-Padded ratchet headband	503	18.0
Convective Heat	1	Legacy 5-Padded ratchet headband	645	18.3
	2	Legacy 5-Padded ratchet headband	620	18.2
	3	Legacy 5-Padded ratchet headband	670	18.1
Radiant Heat	1	Legacy 5-Padded ratchet headband	553	18.3
	2	Legacy 5-Padded ratchet headband	570	17.9
	3	Legacy 5-Padded ratchet headband	494	18.2
Wet	1	Legacy 5-Padded ratchet headband	436	18.0
	2	Legacy 5-Padded ratchet headband	662	17.8
	3	Legacy 5-Padded ratchet headband	720	18.5

OBSERATIONS:

The sample helmets did not transmit a force of more than 3780 N (850 lbf).

TOP IMPACT RESISTANCE TEST - FORCE (Cont'd) (NFPA 1971-2000, Section 6-15)

CONDITION	SAMPLE#	MODEL	PEAK FORCE (lbf)	VELOCITY (ft/sec)
Room Temp	1	Classic-Padded ratchet headband	678	18.0
	2	Classic-Padded ratchet headband	611	18.0
	3	Classic-Under ratchet headband	720	18.0
Low Temp	1	Classic-Padded ratchet headband	796	18.0
	2	Classic-Padded ratchet headband	838	18.0
	3	Classic-Under ratchet headband	838	17.9
Convective Heat	1	Classic-Padded ratchet headband	477	18.4
	2	Classic-Padded ratchet headband	578	17.8
	3	Classic-Under ratchet headband	578	18.2
Radiant Heat	1	Classic-Padded ratchet headband	603	18.1
	2	Classic-Padded ratchet headband	645	18.5
	3	Classic-Under ratchet headband	737	18.2
Wet	1	Classic-Padded ratchet headband	570	17.9
	2	Classic-Padded ratchet headband	695	17.9
	3	Classic-Under ratchet headband	695	18.0

OBSERATIONS:

The sample helmets did not transmit a force of more than 3780 N (850 lbf).

TOP IMPACT RESISTANCE TEST - FORCE (Cont'd) (NFPA 1971-2000, Section 6-15)

CONDITION	SAMPLE#	MODEL	PEAK FORCE (lbf)	VELOCITY (ft/sec)
Room Temp	1	Heritage-Under ratchet headband	678	18.2
	2	Heritage-Under ratchet headband	586	18.2
	3	Heritage-Under ratchet headband	611	17.9
Low Temp	1	Heritage-Under ratchet headband	795	18.3
	2	Heritage-Under ratchet headband	762	17.8
	3	Heritage-Under ratchet headband	787	18.1
Convective Heat	1	Heritage-Under ratchet headband	536	18.1
	2	Heritage-Under ratchet headband	444	18.6
	3	Heritage-Under ratchet headband	477	18.1
Radiant Heat	1	Heritage-Under ratchet headband	544	18.0
	2	Heritage-Under ratchet headband	645	17.8
	3	Heritage-Under ratchet headband	637	18.4
Wet	1	Heritage-Under ratchet headband	544	18.1
	2	Heritage-Under ratchet headband	402	18.4
	3	Heritage-Under ratchet headband	536	18.2

OBSERATIONS:

The sample helmets did not transmit a force of more than 3780 N (850 lbf).

IMPACT RESISTANCE TEST - ACCELERATION (NFPA 1971-2000, Section 6-16)

GENERAL

Three helmets shall be tested after each of the following conditions:

Room Temperature, Low Temperature, Radiant Heat, and Wet Conditioning.

There wil be three helmets for each conditioning for a total of 12 helmets.

6-1.3 - ROOM TEMPERATURE CONDITIONING PROCEDURE FOR HELMETS, FACESHIELD/GOGGLE COMPONENTS: Helmet and faceshield/goggle components shall be conditioned at a temperature of 21°C,±3°(70°F,±5°F) and a relative humidity of 25 percent to 50 percent. Specimens shall be tested within 5 minutes after removal from conditioning.

6-1.4 - LOW TEMPERATURE ENVIRONMENTAL CONDITIONING PROCEDURE FOR HELMETS: Sample specimens shall be conditioned by exposing them to a temperature of -32°C, ±1°C (-25°F, ± 2°F) for at least 4 hours. The impact/penetration test shall be completed within 15 seconds, ±5 seconds after removal from the cold temperature environment, or the specimens shall be reconditioned before testing.

6-1.6 - RADIANT AND CONVECTIVE ENVIRONMENTAL HEAT CONDITIONING PROCEDURE FOR HELMETS: Sample helmets shall be conditioned by exposing the are to be impacted/penetrated to a radiant heat source. The top, sides, front, and back test areas to be impacted/penetrated shall be as specified in Fig. 6-1.6.1.
The area to be impacted/penetrated shall be exposed to a irradiance of 1.0 W/cm^2, ±0.1 W/cm^2 for a length of time determined by exposure of a radiant heat transducer. The heat source shall be removed and the helmet shall be tested. The helmet shall be impact/penetrated in 15 seconds, ±5 seconds after removal from the conditioning environment of the helmet shall be cooled to room temperature and reconditioned before testing.
The radiometer shall have a spectral response to flat within ±3 percent over a range of at least 1.0 mm to 10.1 mm (0.00004 in to 0.0004 in.) and an overall accuracy of at least ±5 percent of the reading.
The radiant panel shall have an effective radiating surface of 150 mm, ±6 in.,±0.25 in.) square. The spectral radiant emittance curve of the radiant panel shall be that of a black body at a temperature of 1000°K, ±200°K (1340°F,±360°F).
The radiant heat transducer shown in Fig. 6-1.6.5 shall be constructed from sheet copper, ASTM B 152, *Specification for Copper Sheet, Strip Plate, and Rolled Bar,* Type 110 ETP, half hard, 0.64 mm, ±5 mm (2 in., ±1/64 in.) square. A constantan wire 0.81 mm, ±0.5 mm (0.032 in., ±0.002 in.) in diameter and an iron wire of the same diameter shall be silver soldered 15 mm, ± 1 mm from the edges of the copper sheet on the same side, as shown in Fig. 6-1.6.5. The side of the copper sheet opposite that with the wires attached shall be painted flat black. The resulting transducer is a Type J thermocouple that shall be used in conjunction with appropriate instrumentation to monitor the heat exposure to which the helmet if to be subjected.

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Sample helmets shall be mounted in the position to be conditioned. The point of impact or penetration on the helmet shall be determined in accordance with the specific test to be performed. the helmet shall be removed temporarily, and a radiometer shall be located at that point perpendicular to and facing away from the helmet surface.
The radiant panel shall be introduced in front of the radiometer with its effective radiating surface parallel to the plane tangent to the helmet surface at the center of the impact/penetration site on the helmet. The radiant panel shall be adjusted to obtain a stable uniform irradiance of 1.0 W/cm^2, W/cm^2 over a minimum 75 mm (3 in.) diameter circle located on the above plane and centered at the center of impact or penetration. Stability shall be achieved when the irradiance changes by less than 10 percent during a 3 minute period.
The radiometer shall be replaced with the radiant heat transducer. The center of the transducer shall be positioned with its center coincident with the center of the impact/penetration site on the helmet and parallel to the plane tangent to the helmet surface at that point. The flat black surface of the transducer shall face the radiant panel. The time required for the transducer to reach a temperature of 260°C (500°F) shall be recorded. That time shall be 2.5 minutes, $\pm$15 seconds. A closed, insulated chamber shall be required to achieve this exposure time.
The chamber and helmet shall be stabilized at 25°C, $\pm$5°C (77°F, $\pm$9°F). The helmet shall be positioned in the chamber in the same position specified in 6-1.6.6. The helmet shall be subjected to the exposure conditions specified in 6-1.6.1 for the time recorded in 6-1.6.8. The exposure time shall not be less than the time recorded in 6-1.6.8, nor more than 5 seconds longer than that time.

6-1.7 WET CONDITIONING PROCEDURE FOR HELMETS AND FACESHIELD/GOGGLE COMPONENTS: Sample specimens shall be conditioned by immersing them in water at a temperature of 20°C to 28°C (68°F to 82°F) for at least 4 hours but not more than 24 hours. The specimen shall be tested within 10 minutes after removal from water.

APPARATUS

An ISO size J headform conforming to the nominal dimensions in Figure 6-16.4.1 shall be used. The ISO size J test headform shall exhibit no resonant frequencies below 3000 Hz, and it shall be made of any low-resonance allow, such as magnesium K-1A.

There shall be a drop assembly consisting of the test headform, the accelerometer, and the moving portion of the headform guidance assembly. The drop assembly shall have a total mass of 5.17 kg, $\pm$0.18 kg (11.4 lb, $\pm$0.4 lb).

The guidance assembly shall comprise not more than 20 percent of the total mass of the total mass of the drop assembly.

The center of mass of the drop assembly shall lie within a cone of 10 degrees included angle about the vertical, with the apex at the point of impact.

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

A steel test anvil shall be used an shall have a smooth, flat striking surface 125 mm, ±15 mm (5 in., ±1/16 in.) in diameter. The anvil shall be mounted securely on a steel plate at least 305 mm (1 ft) square and 25 mm (1 in.) thick. The steel plate shall be rigidly attached to and in intimate contact with a backup mass of at least 540 kg (1200 lb). The backup mass shall be on concrete or a rigid material of equal or greater density at least 610 mm^2 (2 ft^2).

An electronic force measurement system with the following minimum specifications shall be used:

(1) Range - 500 Gn
(2) Peak acceleration measurement - ±2.5 percent accuracy
(3) Resonant frequency - 5000 Hz
(4) Accelerometer shock limit - 2000 Gn
(5) Resolution - 5 Gn

The system frequency response shall comply with SAE J211, *Instrumentation for Impact Test*, Channel Frequency Class 1000, specifications. The time duration of acceleration levels shall be measure to within ±0.2 millisecond.

A reference anvil shall be substituted for the test anvil to verify the calibration of the acceleration measurement system.
The reference anvil shall be constructed of any material that will yield reproducible test results during a period of at least four months.

For calibration, the center of the reference anvil shall be aligned within 3 mm (1/8 in.) of the impact point on the headform. The sensitive axis of the accelerometer shall be aligned within 1 degree of vertical and shall be colinear within 3 mm (1/8 in.), with the center of the reference anvil and the impact point on the headform. The guide or guides shall be vertical and, in the case of a double guide system, parallel to within 6 mm per 3 m (1/4 in. per 10 ft.) of length.

The instrumentation calibration shall be verified at least before and after each test series or at the beginning and end of each day or testing, whichever is the shorter length of time.

The test system shall be analyzed dynamically to ensure that any mechanical resonance does not distort the output data.

Prior to testing, the instrumentation shall be allowed to warm up until stability is achieved.

Throughout the calibration, verification, and testing, the ambient temperature shall be 20°C to 28°C (68°F to 82°F), and the relative humidity shall be 30 percent to 70 percent.

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

METHOD

A conditioned specimen with faceshield/goggle component(s) removed shall be positioned on the headform with the horizontal center plane of the helmet parallel within 5 degrees of the reference plane of the headform and shall be secured to the drop assembly by its retention system so as to maintain this position during the test. No part of the helmet shell shall be cut away to accommodate the test system, and no part of the test system shall contact the helmet shell either as mounted or during an impact test.

The drop assembly with a helmet attached shall be dropped from a height that yields an impact velocity within 2 percent of 6.0 m/sec (19.7 ft/sec). A means of verifying the impact velocity within 2 percent for each impact shall be incorporated in the test system. The acceleration time duration values, peak acceleration, and impact velocity shall be recorded for each test. Each helmet shall be environmentally conditioned prior to each impact in each of the five impact areas specified in Figure 6-1.6.1. Test series number 1 shall require helmet specimens 5, 6, 8, and 10 to be impacted at the front, rear, and side impact areas at a distance of 68 mm, $\pm$13/-0 mm (2 1/2 in., $\pm$0.5/-0 in.) when measured from the test line to the center of the impact anvil.

The impact areas shall be as specified in Figure 6-1.6.1. The top, front, rear, and side areas of the helmet shall be tested.

The top impact area shall consist of a 30 mm (1.2 in.) radius measured from a point located on the headform at the junction of the coronal plane and midsagittal plane.

The front impact test area shall consist of an area defined as extending forward on the headform from the front vertical transverse plane to the test line.

The rear impact test area shall consist of an area as defined as extending backward on the headform from the rear vertical transverse plane extending down to the test line.

The side test areas shall consist of the areas between the top test area and the test line extending from the rear vertical transverse plane and the front vertical transverse plane.

Each conditioned specimen in a series shall be impacted one on the top, rear, front, and side test areas of the helmets as defined in Figure 6-1.6.1. At least one impact shall occur in each test area.

The center of the test anvil shall be lower than 68 mm (2 1/2 in.) above the test line.

The verification tests shall demonstrate an accuracy of 20 percent or better in the measured acceleration.

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

REPORT

The results of each system verification shall be made part of the test results for the specimens being tested.

The maximum acceleration, duration of acceleration above 150 Gn shall be recorded for each test.

INTERPRETATION

Pass or fail performance shall be determined for each specimen. One or more helmet specimens failing this test shall constitute a failing performance.

REQUIREMENTS

Sample helmets shall have no sample exceed the maximum acceleration specified in the following table:

IMPACT LOCATION	MAXIMUM ACCELERATION	m.sec/sec	(ft.sec/sec)
Top	150 x Gn#	1471.5	(4830)
Front	300 x Gn#	2943.0	(9660)
Sides	300 x Gn#	2943.0	(9660)
Back	300 x Gn#	2943.0	(9660)

- Gn denotes gravitational acceleration, which is defined as 9.81 m per second per second (32.2 ft per second per second).

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

RESULTS

Condition: Room Temperature

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Legacy 4-Under ratchet headband	1	Top	116	19.5
	1	Front	152	19.6
	1	Left Side	140	19.6
	1	Right Side	134	19.5
	1	Back	174	19.0
Legacy 4-Under ratchet headband	2	Top	112	19.2
	2	Front	114	19.4
	2	Left Side	126	19.4
	2	Right Side	130	
	2	Back	188	19.7
Legacy 4-Padded ratchet headband	3	Top	104	19.5
	3	Front	108	19.4
	3	Left Side	116	
	3	Right Side	132	
	3	Back	150	19.7

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Low Temperature

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Legacy 4-Under ratchet headband	1	Top	132	19.4
	1	Front	170	19.3
	1	Left Side	122	19.4
	1	Right Side	120	20.1
	1	Back	174	19.4
Legacy 4-Under ratchet headband	2	Top	124	19.5
	2	Front	116	19.7
	2	Left Side	114	19.9
	2	Right Side	142	19.7
	2	Back	148	19.9
Legacy 4-Padded ratchet headband	3	Top	116	19.4
	3	Front	112	19.5
	3	Left Side	110	19.5
	3	Right Side	130	19.9
	3	Back	166	19.7

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Radiant Heat

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Legacy 4-Under ratchet headband	1	Top	116	19.1
	1	Front	98	19.7
	1	Left Side	128	
	1	Right Side	118	19.2
	1	Back	102	19.7
Legacy 4-Under ratchet headband	2	Top	100	19.1
	2	Front	126	19.8
	2	Left Side	150	19.2
	2	Right Side	160	
	2	Back	110	19.5
Legacy 4-Padded headband	3	Top	116	19.2
	3	Front	140	19.5
	3	Left Side	140	
	3	Right Side	122	
	3	Back	144	19.1

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Wet Conditioning

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Legacy 4-Under ratchet headband	1	Top	128	19.1
	1	Front	94	19.6
	1	Left Side	108	19.6
	1	Right Side	172	19.5
	1	Back	144	19.7
Legacy 4-Under ratchet headband	2	Top	108	19.3
	2	Front	130	19.5
	2	Left Side	114	
	2	Right Side	174	24.0
	2	Back	156	19.8
Legacy 4-Padded ratchet headband	3	Top	128	19.4
	3	Front	122	19.4
	3	Left Side	126	19.5
	3	Right Side	192	19.3
	3	Back	154	20.0

OBSERVATIONS

Sample helmets did not exceed the maximum acceleration specified in the following table:

IMPACT LOCATION	MAXIMUM ACCELERATION	m.sec/sec	(ft.sec/sec)
Top	150 x Gn#	1471.5	(4830)
Front	300 x Gn#	2943.0	(9660)
Sides	300 x Gn#	2943.0	(9660)
Back	300 x Gn#	2943.0	(9660)

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

RESULTS

Condition: Room Temperature

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Legacy 5-Padded ratchet headband	1	Top	110	19.6
	1	Front	128	19.5
	1	Left Side	130	
	1	Right Side	134	19.0
	1	Back	156	19.9
Legacy 5-Padded ratchet headband	2	Top	108	19.4
	2	Front	118	19.1
	2	Left Side	114	19.7
	2	Right Side	212	19.7
	2	Back	168	19.3
Legacy 5-Padded ratchet headband	3	Top	118	19.1
	3	Front	142	19.3
	3	Left Side	132	19.3
	3	Right Side	118	19.6
	3	Back	134	19.6

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Low Temperature

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Legacy 5-Padded ratchet headband	1	Top	138	19.4
	1	Front	110	19.9
	1	Left Side	126	19.9
	1	Right Side	110	19.8
	1	Back	192	19.5
Legacy 5-Padded ratchet headband	2	Top	138	19.8
	2	Front	144	19.9
	2	Left Side	96	19.4
	2	Right Side	120	19.3
	2	Back	154	19.6
Legacy 5-Padded ratchet headband	3	Top	120	19.3
	3	Front	102	19.4
	3	Left Side	112	19.6
	3	Right Side	114	19.7
	3	Back	148	19.1

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Radiant Heat

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Legacy 5-Padded ratchet headband	1	Top	90	18.9
	1	Front	136	19.5
	1	Left Side	128	
	1	Right Side	116	
	1	Back	94	19.4
Legacy 5-Padded ratchet headband	2	Top	84	19.6
	2	Front	132	19.3
	2	Left Side	164	19.4
	2	Right Side	110	19.5
	2	Back	96	20.1
Legacy 5-Padded ratchet headband	3	Top	92	19.9
	3	Front	100	19.8
	3	Left Side	138	20.0
	3	Right Side	110	
	3	Back	116	19.5

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Wet Conditioning

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Legacy 5-Padded ratchet headband	1	Top	116	20.0
	1	Front	128	19.4
	1	Left Side	112	
	1	Right Side	158	
	1	Back	140	19.2
Legacy 5-Padded ratchet headband	2	Top	130	19.4
	2	Front	124	18.9
	2	Left Side	140	
	2	Right Side	194	
	2	Back	124	19.7
Legacy 5-Padded ratchet headband	3	Top	128	19.1
	3	Front	94	19.1
	3	Left Side	112	
	3	Right Side	158	19.4
	3	Back	130	19.8

OBSERVATIONS

Sample helmets did not exceed the maximum acceleration specified in the following table:

IMPACT LOCATION	MAXIMUM ACCELERATION	m.sec/sec	(ft.sec/sec)
Top	150 x Gn#	1471.5	(4830)
Front	300 x Gn#	2943.0	(9660)
Sides	300 x Gn#	2943.0	(9660)
Back	300 x Gn#	2943.0	(9660)

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

RESULTS

Condition: Room Temperature

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Classic-Padded ratchet headband	1	Top	106	19.4
	1	Front	64	19.9
	1	Left Side	94	19.2
	1	Right Side	102	19.6
	1	Back	148	20.0
Classic-Padded ratchet headband	2	Top	114	19.5
	2	Front	142	19.0
	2	Left Side	80	19.2
	2	Right Side	92	19.3
	2	Back	150	19.8
Classic-Under ratchet headband	3	Top	102	19.5
	3	Front	70	19.3
	3	Left Side	90	19.7
	3	Right Side	98	19.3
	3	Back	132	

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Low Temperature

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Classic-Padded ratchet headband	1	Top	118	19.4
	1	Front	104	19.9
	1	Left Side	86	19.3
	1	Right Side	126	19.3
	1	Back	206	19.4
Classic-Padded ratchet headband	2	Top	128	19.5
	2	Front	90	19.9
	2	Left Side	102	20.0
	2	Right Side	112	19.5
	2	Back	202	19.7
Classic-Under ratchet headband	3	Top	128	19.7
	3	Front	86	19.1
	3	Left Side	96	19.5
	3	Right Side	110	19.9
	3	Back	158	19.4

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Radiant Heat

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Classic-Padded ratchet headband	1	Top	92	19.6
	1	Front	114	19.6
	1	Left Side	74	19.8
	1	Right Side	94	19.4
	1	Back	152	19.6
Classic-Padded ratchet headband	2	Top	98	
	2	Front	58	19.1
	2	Left Side	72	19.3
	2	Right Side	88	19.7
	2	Back	160	19.5
Classic-Under ratchet headband	3	Top	84	20.1
	3	Front	136	19.8
	3	Left Side	96	19.5
	3	Right Side	96	19.6
	3	Back	154	19.4

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Wet Conditioning

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Classic-Padded ratchet headband	1	Top	84	19.8
	1	Front	118	19.2
	1	Left Side	74	19.7
	1	Right Side	140	19.1
	1	Back	92	19.1
Classic-Padded ratchet headband	2	Top	100	19.0
	2	Front	94	19.9
	2	Left Side	100	19.5
	2	Right Side	162	19.1
	2	Back	104	19.7
Classic-Under ratchet headband	3	Top	100	19.2
	3	Front	132	19.4
	3	Left Side	106	19.6
	3	Right Side	150	19.1
	3	Back	120	19.9

OBSERVATIONS

Sample helmets did not exceed the maximum acceleration specified in the following table:

IMPACT LOCATION	MAXIMUM ACCELERATION	m.sec/sec	(ft.sec/sec)
Top	150 x Gn#	1471.5	(4830)
Front	300 x Gn#	2943.0	(9660)
Sides	300 x Gn#	2943.0	(9660)
Back	300 x Gn#	2943.0	(9660)

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

RESULTS

Condition: Room Temperature

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Heritage-Under ratchet headband	1	Top	96	
	1	Front	104	19.7
	1	Left Side	128	18.9
	1	Right Side	130	19.1
	1	Back	128	19.3
Heritage-Under ratchet headband	2	Top	94	18.9
	2	Front	94	19.5
	2	Left Side	102	19.6
	2	Right Side	104	19.5
	2	Back	142	19.9
Heritage-Under ratchet headband	3	Top	100	19.5
	3	Front	78	19.1
	3	Left Side	86—	19.4
	3	Right Side	104	19.4
	3	Back	148	19.2

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Low Temperature

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Heritage-Under ratchet headband	1	Top	72	21.1
	1	Front	82	19.7
	1	Left Side	94	20.1
	1	Right Side	102	19.5
	1	Back	138	19.6
Heritage-Under ratchet headband	2	Top	104	
	2	Front	68	19.2
	2	Left Side	94	19.6
	2	Right Side	84	19.8
	2	Back	148	19.6
Heritage-Under ratchet headband	3	Top	72	19.4
	3	Front	76	19.8
	3	Left Side	62	19.3
	3	Right Side	88	19.5
	3	Back	200	19.5

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Radiant Heat

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Heritage-Under ratchet headband	1	Top	72	19.6
	1	Front	108	19.5
	1	Left Side	94	19.0
	1	Right Side	142	19.1
	1	Back	176	19.5
Heritage-Under ratchet headband	2	Top	70	19.3
	2	Front	126	19.3
	2	Left Side	134	19.8
	2	Right Side	150	
	2	Back	146	19.9
Heritage-Under ratchet headband	3	Top	72	19.8
	3	Front	92	19.0
	3	Left Side	154	19.6
	3	Right Side	88	19.5
	3	Back	154	19.8

IMPACT RESISTANCE TEST - ACCELERATION (Cont'd) (NFPA 1971-2000, Section 6-16)

Condition: Wet Conditioning

MODEL	SAMPLE	IMPACT LOCATION	MAX ACCEL.	VEL ft/sec
Heritage-Under ratchet headband	1	Top	82	19.8
	1	Front	82	19.8
	1	Left Side	218	19.7
	1	Right Side	224	19.4
	1	Back	148	19.2
Heritage-Under ratchet headband	2	Top	78	19.3
	2	Front	92	19.5
	2	Left Side	288	19.5
	2	Right Side	212	19.1
	2	Back	168	19.3
Heritage-Under ratchet headband	3	Top	84	19.3
	3	Front	80	20.1
	3	Left Side	110	19.3
	3	Right Side	182	19.1
	3	Back	144	20.1

OBSERVATIONS

Sample helmets did not exceed the maximum acceleration specified in the following table:

IMPACT LOCATION	MAXIMUM ACCELERATION	m.sec/sec	(ft.sec/sec)
Top	150 x Gn#	1471.5	(4830)
Front	300 x Gn#	2943.0	(9660)
Sides	300 x Gn#	2943.0	(9660)
Back	300 x Gn#	2943.0	(9660)

PHYSICAL PENETRATION RESISTANCE TEST - (NFPA 1971-2000, Section 6-19)

GENERAL

Three helmets shall be tested after each of the following conditions:

Room Temperature, Low Temperature, Convective Heat, Radiant Heat, and Wet Conditioning.

There will be three helmets for each conditioning for a total of 15 helmets.

6-1.3 - ROOM TEMPERATURE CONDITIONING PROCEDURE FOR HELMETS, FACESHIELD/GOGGLE COMPONENTS: Helmet and faceshield/goggle components shall be conditioned at a temperature of 21°C, ±3°(70°F, ±5°F) and a relative humidity of 25 percent to 50 percent. Specimens shall be tested within 5 minutes after removal from conditioning.

6-1.4 - LOW TEMPERATURE ENVIRONMENTAL CONDITIONING PROCEDURE FOR HELMETS: Sample specimens shall be conditioned by exposing them to a temperature of -32°C, ±1°C (-25°F, ± 2°F) for at least 4 hours. The impact/penetration test shall be completed within 15 seconds, ±5 seconds after removal from the cold temperature environment, or the specimens shall be reconditioned before testing.

6-1.5 - CONVECTIVE HEAT CONDITIONING PROCEDURE FOR HELMETS: Samples shall be conditioned by exposing them to the following procedures specified:

The test oven shall be a horizontal flow circulating oven with the minimum interior dimensions of 610 mm x 610 mm x 610 mm (24 in. x 24 in. x 24 in.).

The test thermocouple shall be positioned so that it is level with the horizontal centerline of a mounted test helmet. The thermocouple shall be equidistant between the vertical centerline of a mounted test helmet placed in the middle of the oven and the oven wall where the airflow enters the test chamber.

The test oven temperature shall be stabilized at 140°C, +6°C/-0°C (285°F, +10°F/0°F) for a period of not less than 30 mins., +15/-0 seconds.

Helmets with ear covers deployed and with the faceshield/goggle component in the stowed position shall be seated on the noncunductive headform specified in Firgure 6-6.12.3 and shall be positioned according to the helmet's positioning index. The headform with the helmet attached shall be placed in the center of hte test oven with the centerline of the front of the helmet facing the airflow.

The oven door shall not remain open more than 15 seconds. The air circulation shall be shut off while the door is open sand turn on when the door is closed. The total oven recovery time after the door is closed shall not exceed 30 seconds.

One helmet shall be tested at a time. The entire specimen shall not be less than 50 mm (2 in.) from any oven surface.

The specimen, mounted as specified, shall be exposed in the test oven for 10 minutes, +0.15/-0 minute. The test exposure time shall begin when the thermocouple recovers to a temperature of 140°C, +6°C/-0°C, (285°F, +10°F/-0°F).

The required testing shall be performed within 15 seconds, +/-5 seconds.

6-1.6 - RADIANT AND CONVECTIVE ENVIRONMENTAL HEAT CONDITIONING PROCEDURE FOR HELMETS: Sample helmets shall be conditioned by exposing the are to be impacted/penetrated to a radiant heat source. The top, sides, front, and back test areas to be impacted/penetrated shall be as specified in Fig. 6-1.6.1.
The area to be impacted/penetrated shall be exposed to a irradiance of 1.0 W/cm^2, $\pm$0.1 W/cm^2 for a length of time determined by exposure of a radiant heat transducer. The heat source shall be removed and the helmet shall be tested. The helmet shall be impact/penetrated in 15 seconds, $\pm$5 seconds after removal from the conditioning environment of the helmet shall be cooled to room temperature and reconditioned before testing.
The radiometer shall have a spectral response to flat within $\pm$3 percent over a range of at least 1.0 mm to 10.1 mm (0.00004 in to 0.0004 in.) and an overall accuracy of at least $\pm$5 percent of the reading.
The radiant panel shall have an effective radiating surface of 150 mm, $\pm$6 in.,$\pm$0.25 in.) square. The spectral radiant emittance curve of the radiant panel shall be that of a black body at a temperature of 1000°K, $\pm$200°K (1340°F,$\pm$360°F).

The radiant heat transducer shown in Fig. 6-1.6.5 shall be constructed from sheet copper, ASTM B 152, *Specification for Copper Sheet, Strip Plate, and Rolled Bar,* Type 110 ETP, half hard, 0.64 mm, $\pm$5 mm (2 in., $\pm$1/64 in.) square. A constantan wire 0.81 mm, $\pm$0.5 mm (0.032 in., $\pm$0.002 in.) in diameter and an iron wire of the same diameter shall be silver soldered 15 mm, $\pm$ 1 mm from the edges of the copper sheet on the same side, as shown in Fig. 6-1.6.5. The side of the copper sheet opposite that with the wires attached shall be painted flat black. The resulting transducer is a Type J thermocouple that shall be used in conjunction with appropriate instrumentation to monitor the heat exposure to which the helmet if to be subjected.

Sample helmets shall be mounted in the position to be conditioned. The point of impact or penetration on the helmet shall be determined in accordance with the specific test to be performed. the helmet shall be removed temporarily, and a radiometer shall be located at that point perpendicular to and facing away from the helmet surface.

PHYSICAL PENETRATION RESISTANCE TEST (Cont'd) - (NFPA 1971-2000, Section 6-19)

The radiant panel shall be introduced in front of the radiometer with its effective radiating surface parallel to the plane tangent to the helmet surface at the center of the impact/penetration site on the helmet. The radiant panel shall be adjusted to obtain a stable uniform irradiance of 1.0 W/cm^2, W/cm^2 over a minimum 75 mm (3 in.) diameter circle located on the above plane and centered at the center of impact or penetration. Stability shall be achieved when the irradiance changes by less than 10 percent during a 3 minute period.

The radiometer shall be replaced with the radiant heat transducer. The center of the transducer shall be positioned with its center coincident with the center of the impact/penetration site on the helmet and parallel to the plane tangent to the helmet surface at that point. The flat black surface of the transducer shall face the radiant panel. The time required for the transducer to reach a temperature of 260°C (500°F) shall be recorded. That time shall be 2.5 minutes, ±15 seconds. A closed, insulated chamber shall be required to achieve this exposure time.

The chamber and helmet shall be stabilized at 25°C, ±5°C (77°F, ±9°F). The helmet shall be positioned in the chamber in the same position specified in 6-1.6.6. The helmet shall be subjected to the exposure conditions specified in 6-1.6.1 for the time recorded in 6-1.6.8. The exposure time shall not be less than the time recorded in 6-1.6.8, nor more than 5 seconds longer than that time.

6-1.7 WET CONDITIONING PROCEDURE FOR HELMETS AND FACESHIELD/GOGGLE COMPONENTS: Sample specimens shall be conditioned by immersing them in water at a temperature of 20°C to 28°C (68°F to 82°F) for at least 4 hours but not more than 24 hours. The specimen shall be tested within 10 minutes after removal from water.

APPARATUS

An ISO size J headform conforming to the nominal dimensions in Figure 6-16.4.1 shall be used. Above the test line, it shall have an electrically conductive surface that is electrically connected to the contact indicator.

The penetration striker shall have a mass of 1 kg +0.02/-0.0 kg (2.2 lb, +0.01/-0.0 lb). The point of the striker shall be a cone with an included angle of 60 degrees, ±0.5 degree, a height of 38 mm (1/2 in.), and a tip radius of 0.5 mm, ±1 mm (0.020 in., ±0.004 in.). The hardness of the striking tip shall be Rockwell Scale C-60, minimum. The penetration striker shall be electrically connected to the contact indicator.

The contact indicator shall indicate when electrical contact has been made between the penetration striker and the conductive surface of the test headform. The contact indicator shall have a response time of less than 0.5 second.

The test shall be conducted at an ambient temperature of 20°C to 28°C (68°F to 82°F), and the relative humidity shall be 30 percent to 70 percent.

PHYSICAL PENETRATION RESISTANCE TEST (Cont'd) - (NFPA 1971-2000, Section 6-19)

PROCEDURE

The environmentally conditioned helmet shall be placed on the rigidly mounted test headform and secured by the helmet retention system or by other means that will not interfere with the test. The helmet shall be positioned so the penetration striker shall impact perpendicular to the helmet anywhere above the test line. The impact site shall be at least 75 mm (3 in.) from the center of a previous penetration or impact site.

The drop height of the penetration striker shall be adjusted so that the velocity at impact is at 7 m/s, $\pm$0.1 m/s (23 ft/s, $\pm$0.5 ft/s). A total of two penetration tests for each of the five environmental conditions specified (6-1.3, 6-1.4, 6-1.5, 6-1.6, and 6-1.7) shall be conducted in such a manner that at least one penetration test shall be performed in each of the test areas defined in Figure 6-1.6.1. The helmet shall be environmentally conditioned prior to each penetration test. A minimum of two penetration test blows shall be applied at different test areas on each helmet.

REPORT

The pass or fail result for each helmet shall be reported.

INTERPRETATION

One or more helmet specimens failing this test shall constitute failing performance.

REQUIREMENT

Sample helmets shall exhibit no electrical or physical contact between the penetration test striker and the headform.

PHYSICAL PENETRATION RESISTANCE TEST (Cont'd) - (NFPA 1971-2000, Section 6-19)

RESULTS

SAMPLE NUMBER 1 HELMET MODEL: Legacy 4-Under ratched headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Top	Pass	
ROOM TEMPERATURE	Front	Pass	
LOW TEMPERATURE	Left	Pass	22.5
LOW TEMPERATURE	Right	Pass	
CONVECTIVE HEAT	Left	Pass	
CONVECTIVE HEAT	Right	Pass	
RADIANT HEAT	Top	Pass	22.4
RADIANT HEAT	Rear	Pass	23.1
WET	Front	Pass	
WET	Rear	Pass	

SAMPLE NUMBER 2 HELMET MODEL: Legacy 4-Under ratched headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Left	Pass	
ROOM TEMPERATURE	Right	Pass	
LOW TEMPERATURE	Top	Pass	
LOW TEMPERATURE	Rear	Pass	
CONVECTIVE HEAT	Rear	Pass	
CONVECTIVE HEAT	Front	Pass	
RADIANT HEAT	Left	Pass	
RADIANT HEAT	Right	Pass	
WET	Front	Pass	22.2
WET	Top	Pass	

SAMPLE NUMBER 3 HELMET MODEL: Legacy 4-Padded ratched headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Top	Pass	23.1
ROOM TEMPERATURE	Rear	Pass	
LOW TEMPERATURE	Front	Pass	
LOW TEMPERATURE	Right	Pass	
CONVECTIVE HEAT	Top	Pass	
CONVECTIVE HEAT	Rear	Pass	22.6
RADIANT HEAT	Front	Pass	
RADIANT HEAT	Left	Pass	22.6
WET	Left	Pass	22.5
WET	Right	Pass	

OBSERVATION

Sample helmets did not exhibit electrical or physical contact between the penetration test striker and the headform.

PHYSICAL PENETRATION RESISTANCE TEST (Cont'd) - (NFPA 1971-2000, Section 6-19)

SAMPLE NUMBER 1 HELMET MODEL: Legacy 5-Padded ratchet headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Top	Pass	
ROOM TEMPERATURE	Front	Pass	
LOW TEMPERATURE	Left	Pass	
LOW TEMPERATURE	Right	Pass	22.6
CONVECTIVE HEAT	Left	Pass	21.9
CONVECTIVE HEAT	Right	Pass	22.6
RADIANT HEAT	Top	Pass	
RADIANT HEAT	Rear	Pass	23.3
WET	Front	Pass	22.0
WET	Rear	Pass	

SAMPLE NUMBER 2 HELMET MODEL: Legacy 5-Padded ratchet headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Left	Pass	22.7
ROOM TEMPERATURE	Right	Pass	22.5
LOW TEMPERATURE	Top	Pass	
LOW TEMPERATURE	Rear	Pass	22.9
CONVECTIVE HEAT	Rear	Pass	
CONVECTIVE HEAT	Front	Pass	
RADIANT HEAT	Left	Pass	22.4
RADIANT HEAT	Right	Pass	
WET	Front	Pass	26.5
WET	Top	Pass	22.7

SAMPLE NUMBER 3 HELMET MODEL: Legacy 5-Padded ratchet headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Top	Pass	22.9
ROOM TEMPERATURE	Rear	Pass	
LOW TEMPERATURE	Front	Pass	
LOW TEMPERATURE	Right	Pass	
CONVECTIVE HEAT	Top	Pass	
CONVECTIVE HEAT	Rear	Pass	21.9
RADIANT HEAT	Front	Pass	
RADIANT HEAT	Left	Pass	22.3
WET	Left	Pass	22.3
WET	Right	Pass	22.3

OBSERVATION

Sample helmets did not exhibit electrical or physical contact between the penetration test striker and the headform.

PHYSICAL PENETRATION RESISTANCE TEST (Cont'd) - (NFPA 1971-2000, Section 6-19)

SAMPLE NUMBER 1 HELMET MODEL: Classic-Padded ratchet headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Top	Pass	
ROOM TEMPERATURE	Front	Pass	
LOW TEMPERATURE	Left	Pass	
LOW TEMPERATURE	Right	Pass	23.3
CONVECTIVE HEAT	Left	Pass	
CONVECTIVE HEAT	Right	Pass	
RADIANT HEAT	Top	Pass	23.0
RADIANT HEAT	Rear	Pass	21.9
WET	Front	Pass	22.6
WET	Rear	Pass	

SAMPLE NUMBER 2 HELMET MODEL: Classic-Padded ratchet headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Left	Pass	
ROOM TEMPERATURE	Right	Pass	22.6
LOW TEMPERATURE	Top	Pass	23.0
LOW TEMPERATURE	Rear	Pass	
CONVECTIVE HEAT	Rear	Pass	
CONVECTIVE HEAT	Front	Pass	
RADIANT HEAT	Left	Pass	22.2
RADIANT HEAT	Right	Pass	22.7
WET	Front	Pass	
WET	Top	Pass	

SAMPLE NUMBER 3 HELMET MODEL: Classic-Under ratchet headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Top	Pass	23.0
ROOM TEMPERATURE	Rear	Pass	
LOW TEMPERATURE	Front	Pass	22.1
LOW TEMPERATURE	Right	Pass	22.7
CONVECTIVE HEAT	Top	Pass	
CONVECTIVE HEAT	Rear	Pass	22.2
RADIANT HEAT	Front	Pass	
RADIANT HEAT	Left	Pass	22.9
WET	Left	Pass	
WET	Right	Pass	22.8

OBSERVATION

Sample helmets did not exhibit electrical or physical contact between the penetration test striker and the headform.

PHYSICAL PENETRATION RESISTANCE TEST (Cont'd) - (NFPA 1971-2000, Section 6-19)

SAMPLE NUMBER 1 HELMET MODEL: Heritage-Under ratchet headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Top	Pass	23.7
ROOM TEMPERATURE	Front	Pass	22.8
LOW TEMPERATURE	Left	Pass	22.7
LOW TEMPERATURE	Right	Pass	
CONVECTIVE HEAT	Left	Pass	
CONVECTIVE HEAT	Right	Pass	
RADIANT HEAT	Top	Pass	
RADIANT HEAT	Rear	Pass	22.5
WET	Front	Pass	
WET	Rear	Pass	21.9

SAMPLE NUMBER 2 HELMET MODEL: Hertitage-Under ratchet headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Left	Pass	
ROOM TEMPERATURE	Right	Pass	23.1
LOW TEMPERATURE	Top	Pass	23.1
LOW TEMPERATURE	Rear	Pass	23.0
CONVECTIVE HEAT	Rear	Pass	
CONVECTIVE HEAT	Front	Pass	22.9
RADIANT HEAT	Left	Pass	22.4
RADIANT HEAT	Right	Pass	
WET	Front	Pass	22.4
WET	Top	Pass	

SAMPLE NUMBER 3 HELMET MODEL: Heritage-Under ratchet headband

CONDITION	IMPACT LOCATION	PASS/FAIL	VELOCITY (ft/sec)
ROOM TEMPERATURE	Top	Pass	
ROOM TEMPERATURE	Rear	Pass	
LOW TEMPERATURE	Front	Pass	
LOW TEMPERATURE	Right	Pass	23.1
CONVECTIVE HEAT	Top	Pass	22.9
CONVECTIVE HEAT	Rear	Pass	22.7
RADIANT HEAT	Front	Pass	
RADIANT HEAT	Left	Pass	21.6
WET	Left	Pass	22.4
WET	Right	Pass	

OBSERVATION

Sample helmets did not exhibit electrical or physical contact between the penetration test striker and the headform.